CLAIMS

1. A device for the noninvasive detection of the properties of a medium by interferometry, this device comprising:

- an optical source (3) for illuminating at least one region (34) of the medium to be probed, with a light beam (19) whose path defines an optical axis;
- means (7) for measuring the variations in the phase of the light beam during its passage through the region (34) to be probed, these measurement means
  - · comprising an interferometer (5) for splitting the light beam (19) into a reference beam (21) and a probe beam (23), in this interferometer (5) the servocontrol of the respective path lengths of the reference beam (21) and of the probe beam (23) being active up to a cutoff frequency f_c and
  - · having a signal sampling frequency f_a,

characterized in that it includes scanning means (33) suitable for scanning, with the probe beam (23), the region (34) to be probed and a reference region (36) with an image acquisition frequency f for the images recorded by the means (7) for measuring the variations in the phase of the light beam above the cutoff frequency f_c.

2. The device as claimed in claim 1, in which the scanning means (33) scan the region (34) to be probed and the reference region (36) along a first direction in space at a frequency f_x and along a second direction in space at a frequency f_y, in order to form an image of n pixels along the first direction and m pixels along the second direction, the frequencies f_x and f_y being chosen such that $f_x = f_y/n$ and $f_y = f_a/m$, f_x and f_y being greater than f_c.

3. The device as claimed in either of claims 1 and 2, in which the means (7) for measuring the variations in the phase of the light beam comprise a confocal microscope (15) in which the region (34) to be probed is placed in a manner suitable for forming an image of a plane of the region (34) to be probed.

4. The device as claimed in one of the preceding claims, comprising means for moving the medium, along the three directions in space, in the probe beam (23).

5. The device as claimed in one of the preceding claims, in which the scanning means (33) comprise four acoustooptic deflectors (35), two for deflecting the light beam, upstream of the confocal microscope (15), each in one of the first and second directions in space respectively, and two for rectifying the light beam, each in one of the first and second directions in space respectively, downstream of the confocal microscope (15).

6. The device as claimed in claim 5, in which at least one acoustooptic deflector (35), downstream of the confocal microscope (15) is set so as to make the 0th-order of the light beam inclined to the optical axis and to retain the paraxial 1st-order.

7. The device as claimed in claim 6, comprising a Galileo telescope for increasing the angle α between the 1st-order and the optical axis.

8. The device as claimed in one of the preceding claims, which further includes, upstream of the confocal microscope (15), means (37) for controlling the polarization of the probe beam (23) incident on the region (34) to be probed.

9. A method of noninvasively detecting the properties of a medium by interferometry, in which:

- at least one region (34) of the medium to be probed is illuminated with an optical source (3) that generates a light beam (19), the path of which defines an optical axis;

- an interferometer (5) is used to split the light beam (19) into a reference beam (21) and a probe beam (23) and to measure the phase shift between the reference beam (21) and the probe beam (23) after the latter has passed through the region (34) to be probed;

- the respective path lengths of the reference beam (21) and the probe beam (23) are servocontrolled by photodetection means (29); and

- images corresponding to the measurement of the phase shift at various points in the region (34) to be probed are acquired, with the photodetection means (29), at a signal sampling frequency f_a above the cutoff frequency f_c for servocontrolling the respective path lengths of the reference beam (21) and the probe beam (23),

characterized in that the region (34) to be probed and a reference region (36) are scanned with the probe beam (23) at an image acquisition frequency f for images recorded by the means (7) for measuring the variations in the phase of the light beam above the cutoff frequency f_c.

10. The method as claimed in claim 9, in which the region (34) to be probed and the reference region (36) are scanned along a first direction in space at a frequency f_x and along a second direction in space at a frequency f_y, in order to form an image of n pixels along the first direction and m pixels along the second direction, the frequencies f_x and f_y being chosen such that $f_x = f_y/n$ and $f_y = f_a/m$, f_x and f_y being greater than f_c.

11. The method as claimed in either of claims 9 and 10, in which the region (34) to be probed is placed in a confocal microscope (15) in a manner suitable for

forming an image of one plane of the region (34) to be probed.

12. The method as claimed in one of claims 9 to 11, in which the medium is moved, along the three directions in space, in the probe beam (23).

13. The method as claimed in one of claims 9 to 12, in which the medium is excited at a frequency f_e and the variation in the phase of the probe beam (23) relative to that of the reference beam (21) is measured at this same frequency f_e.

14. The method as claimed in one of claims 9 to 13, in which the 0th-order of the light beam is deflected relative to the optical axis by means of at least one acoustooptic deflector (35), downstream of the confocal microscope, and the paraxial 1st-order is retained.

15. The method as claimed in claim 14, in which the angle α between the 1st-order and the optical axis is increased by means of a Galileo telescope.

16. The method as claimed in one of claims 9 to 15, in which the region (34) to be probed includes at least one part of an optoelectronic component to which a potential is applied.

17. The method as claimed in claim 16, in which the potential is applied via at least one electrode, the shape of which is suitable for creating an electric field gradient.

18. The method as claimed in either of claims 16 and 17, in which the potential is applied via at least one multipolar electrode.

19. The method as claimed in one of claims 16 to 18, in which the optoelectronic component is placed in an optically active medium.

20. The method as claimed in one of claims 16 to 19, in which the propagation of an electrical pulse in the optoelectronic component is studied.

21. The method as claimed in one of claims 9 to 15, in which the region (34) to be probed includes at least one part of a fractal aggregate.

22. The method as claimed in one of claims 9 to 15, in which the region (34) to be probed includes at least one part of a biological medium.

23. The method as claimed in claim 22, in which the region (34) to be probed includes at least one part of a biological membrane.

24. The method as claimed in either of claims 22 and 23, in which the region (34) to be probed includes at least one part of a neuron or of a neural network.

25. The method as claimed in one of claims 9 to 15, in which the region (34) to be probed includes at least one part of an artificial membrane.

26. The method as claimed in one of claims 9 to 15, in which the region (34) to be probed constitutes at least one part of a chemical medium.

27. The method as claimed in one of claims 9 to 26, in which the medium is doped with molecules or ions having electrooptic properties, or conferring electrooptic properties on the medium, so as to accentuate the electrooptic properties of the medium, if the latter is already endowed therewith, or to reveal the presence of

electric fields in a medium that does not possess such properties intrinsically.

28. The method as claimed in one of claims 9 to 27, in which, knowing the distribution of the electrooptic properties of the medium, a mapping of the electric field in the medium is carried out.

29. The method as claimed in one of claims 9 to 27, in which an electric field of known configuration is generated in the medium so as to reveal electrooptic properties of the medium.